

INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

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COUNTRY USSR

REPORT NO. [REDACTED]

SUBJECT Sizes of Cosmos Series of Satellites Determined on Basis of Mass/Area Ratio and Luminosity Data/Similar Data on US Satellites for Comparative Purposes

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1. Based upon observed mass/area ratios in a dynamic model atmosphere with expected time variations, combined with 150 luminosity observations (optical and world-wide) obtained from the Smithsonian, we have been able to compute the following size data on the Soviet series of Cosmos satellites. We also used the same type of formulas to compute similar data for several US satellites, for comparative purposes:

Satellite	M/Ac (g/cm ²)	Ac (cm ²)
a. Cosmos 1	7.26 ± 0.89	2.71 (± 0.92) × 10 ³
Cosmos 1 Rocket	11.4 ± 1.28	3.76 (± 0.70) × 10 ⁵
b. Cosmos 2	26.5 ± 2.46	1.15 (± 0.30) × 10 ⁴
Cosmos 2 Rocket	7.83 ± 2.10	1.20 (± 1.27) × 10 ⁵
c. Cosmos 3	24.3 ± 3.32	1.21 (± 0.55) × 10 ⁴
Cosmos 3 Rocket	12.5 ± 1.62	1.83 (± 0.40) × 10 ⁵
d. Cosmos 4	19.4 ± 1.41	5.71 (± 1.40) × 10 ⁴
Cosmos 4 Rocket	19.3 ± 5.44	2.30 (± 1.13) × 10 ⁵
e. Cosmos 5	22.0 ± 3.75	1.77 (± 0.30) × 10 ⁴
Cosmos 5 Rocket	11.3 ± 2.13	2.42 (± 0.55) × 10 ⁵
f. Cosmos 6	26.7 ± 1.04	5.00 (± 4.10) × 10 ⁴
Cosmos 6 Rocket	15.5 ± 1.09	4.34 (± 0.62) × 10 ⁵

Approved for Release

Date SEP 1996

GROUP 1
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downgrading and
declassification

STATE ARMY NAVY AIR FBI AEC

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31

Estellite	ρ/ρ_0 (g/cm ³)	A_0 (cm ²)
2. Cosmos 7	62.9 \pm 8.70	1.63 (\pm 0.99) $\times 10^5$
Cosmos 7 Rocket	82.4 \pm 2.70	2.47 (\pm 2.82) $\times 10^5$
2. Cosmos 8	32.7 \pm 3.34	9.68 (\pm 3.46) $\times 10^3$
Cosmos 8 Rocket	12.3 \pm 1.68	2.61 (==) $\times 10^5$
1. Vostoks III & IV	62.9 \pm 8.70	1.13 (\pm 1.65) $\times 10^5$
1. 62 C - gamma	17.6 \pm 0.77	1.16 $\times 10^5$
2. 62 C - eta	12.6 \pm 2.00	1.16 $\times 10^5$
1. 62 Sigma	27.9 \pm 6.16	1.16 $\times 10^5$
2. 62 C - kappa	11.1 \pm 3.06	1.16 $\times 10^5$
2. 62 C - Theta	17.8 \pm 2.00	1.16 $\times 10^5$

Shape	Tha.	Approximate Size (in feet)	
(g)			
a. 1.97 (\pm 0.71) $\times 10^4$	44.8 \pm 16	1.9 \pm 1.1	S
4.29 (\pm 0.99) $\times 10^6$	9445 \pm 2576	9.0 (\pm 4.0) \times 45.0 (\pm 20.2)	T
b. 2.81 (\pm 0.78) $\times 10^5$	620 \pm 171	4.0 \pm 2.0	S
1.86 (\pm 1.31) $\times 10^6$	4210 \pm 1000	6.4 (\pm 5.2) \times 32.0 (\pm 26.0)	T
c. 2.94 (\pm 1.49) $\times 10^5$	640 \pm 320	4.1 \pm 2.8	S
2.25 (\pm 0.58) $\times 10^6$	5040 \pm 1287	6.3 (\pm 2.9) \times 31.5 (\pm 14.5)	T
d. 1.11 (\pm 0.29) $\times 10^6$	2441 \pm 647	8.8 \pm 4.5	S
4.45 (\pm 2.32) $\times 10^6$	9791 \pm 2003	7.0 (\pm 4.9) \times 35.0 (\pm 24.5)	T
e. 3.95 (\pm 0.54) $\times 10^5$	870 \pm 206	5.0 \pm 2.0	S
2.85 (\pm 0.92) $\times 10^6$	6200 \pm 2030	7.2 (\pm 3.7) \times 36.0 (\pm 18.5)	T
f. 1.36 (\pm 1.11) $\times 10^6$	2509 \pm 2453	8.3 \pm 7.6	S
6.73 (\pm 1.08) $\times 10^6$	14,800 \pm 2370	9.7 (\pm 3.7) \times 48.5 (\pm 18.5)	T
g. 1.02 (\pm 0.64) $\times 10^7$	22,700 \pm 14,000	14.9 \pm 11.6	S
5.55 (\pm 0.30) $\times 10^6$	12,200 \pm 6530	7.3 (\pm 5.3) \times 36.5 (\pm 26.4)	T
h. 3.17 (\pm 1.18) $\times 10^5$	697 \pm 259	3.6 \pm 2.2	S
3.21 (==) $\times 10^6$	7000 \pm ==	7.5 (==) \times 37.5 (==)	T
i. 7.15 (\pm 10.4) $\times 10^6$	15,750 \pm 22,940	12.5 \pm 15.0	S
j. 2.04 (\pm 0.09) $\times 10^6$	4490 \pm 197	3.0 \times 25.0	T
k. 2.16 (\pm 0.23) $\times 10^6$	4760 \pm 987	5.0 \times 25.0	T
l. 3.24 (\pm 0.72) $\times 10^6$	7140 \pm 1790	5.0 \times 25.0	T
m. 1.29 (\pm 0.36) $\times 10^6$	2540 \pm 791	5.0 \times 25.0	T
n. 2.06 (\pm 0.24) $\times 10^6$	4540 \pm 529	5.0 \times 25.0	T

[S = sphere shaped, diameter; T = tube shaped; diameter & length]

** Based on only one
optical observation.

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NATIONAL INTELLIGENCE ESTIMATE

NUMBER 11-5-53

(Supersedes NIE 11-5-52, SNIE 11-10-52,
and portions of NIE 11-4-52)

SOVIET CAPABILITIES IN GUIDED MISSILES AND SPACE VEHICLES

APPROVED FOR RELEASE
ON 10/10/2001 BY NSA

Submitted by the
DIRECTOR OF CENTRAL INTELLIGENCE

The following intelligence organizations participated in the
preparation of this estimate: the Central Intelligence Agency
and the intelligence organizations of the Department of
State, the Army, the Navy, the Air Force, the Joint Staff,
and the Atomic Energy Commission.

Concurred in by the
INTELLIGENCE ADVISORY COMMITTEE

On 19 August 1953, (Concurring were) the Director of Central
Intelligence, the Director of State, the Assistant
Director of State for Intelligence, the Director of Naval
Intelligence, the Assistant Chief of Staff for Intelligence,
the Chief of Staff, the Director of the Joint Staff,
the Atomic Energy Commission, the Assistant
Director of the Federal Bureau of Investigation,
and the Assistant Director of the Central Intelligence Agency.

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TABLE OF CONTENTS

	Page
THE PROBLEM	1
FOREWORD	1
SUMMARY AND CONCLUSIONS	2
SIMPLIFIED TABULAR SUMMARY	6
DISCUSSION	7
I. AIR DEFENSE MISSILE SYSTEMS	7
The Threat and Soviet Requirements	7
Development Capabilities and Programs	8
Surface-to-Air Systems	8
Air-to-Air Systems	10
Factors Affecting Operational Capabilities	11
II. AIR-TO-SURFACE MISSILE SYSTEMS	13
Soviet Requirements	13
Development Capabilities and Programs	13
Factors Affecting Operational Capabilities	14
III. SURFACE-TO-SURFACE MISSILE SYSTEMS	15
Soviet Requirements	15
Factors Affecting Development Capabilities	15
Ground-Launched Systems	16
Development Capabilities and Programs	16
Factors Affecting Operational Capabilities	20
Naval-Launched Systems	22
Special Problems Affecting Naval-Launched Missile Capabilities	22
Capabilities and Programs	23
IV. SPACE PROGRAM	26
General Scope of Program	26
Factors Affecting Accomplishment of Program	27
Capabilities to Accomplish Specific Objectives	28

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TABLE OF CONTENTS—Continued

ANNEXES

- ANNEX A — Detailed Tabular Summary, Probable Soviet Guided
Missile Development Programs and Possible Soviet
Space Development Program 30
- ANNEX B — Soviet Guided Missile Test Ranges, Testing, and Mis-
sile Associated Activities
(limited distribution under separate cover)
- ANNEX C — Estimated Nuclear Warhead Capabilities
(limited distribution under separate cover)

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IV. SPACE PROGRAM

GENERAL SCOPE OF PROGRAM

Objectives

106. Soviet objectives relating to space vehicles cannot be regarded as requirements in the usual sense of weapons systems needed to oppose or counterbalance an enemy's military capabilities. In fact, immediate or known military considerations may have no bearing on the decision to develop certain types of space vehicles, although the successful development of these vehicles could result in military applications.

107. We believe that the ultimate foreseeable objective of the Soviet space program is the attainment of manned space travel on an interplanetary scale. At present the program appears to be directed toward the collection of scientific data which would be applicable to Soviet space activities, ICBM program and basic scientific research. While the Soviet space program was undoubtedly initiated to serve scientific purposes, an immediate aim was to achieve political and propaganda gain. Soviet earth satellite launchings to date have ostensibly been in support of the IGY, although the USSR has revealed almost no significant data to the West. Future Soviet programs probably will be established for fairly specific scientific and/or military purposes in accordance with a planned, step-by-step progression from one achievement to the next. We believe that the Soviet space program aims to acquire greater knowledge of the earth and the universe, together with the national advantages to be derived from this knowledge.

108. We estimate that the Soviet space program will be directed toward the following specific objectives:

— *Unmanned satellites.* There will be a continuing requirement during this period for unmanned instrumented satellites to accumulate scientific data on space, as well as surveillance satellites to obtain weather data, geodetic information, and other information of intelligence value.

— *Lunar rockets.* An important Soviet objective is to acquire scientific data on the moon. This data can be collected by unmanned rockets launched to the vicinity of the moon (lunar probes), by unmanned lunar satellites, and by soft or hard impacts on the moon.

— *Recoverable satellites.* Successful experiments with recoverable satellites, including those containing animals, are essential to the attainment of subsequent objectives.

— *Manned earth orbital flights.* Test flights with manned high altitude research vehicles (rockets or boost glide) probably will be required to obtain necessary data on the environment of outer space. Manned flights will probably increase in altitude and duration, prior to the orbiting of a recoverable manned satellite. In recent months, several Soviet sources have stated that a manned space vehicle is feasible and is one of the USSR's prime objectives.

— *Planetary probes.* Rocket probes probably will be launched toward Mars and Venus in order to obtain scientific data not otherwise available from earth satellites and lunar rockets.

— *Manned lunar flights.* Circumlunar flights by manned space vehicles and eventually lunar landings.

— *Manned interplanetary flight.* This is the announced ultimate goal of the Soviet space flight program.

Organization and Priority

109. After about 50 years of general scientific interest in astronautics and space flight, and governmental interest beginning in 1934, the first consolidated attack on the problem by the USSR was announced in April 1955 with the establishment of the Interagency Commission for Interplanetary Communications. There are some indications that this organization may have been in existence and active

as early as the fall of 1954. Its charter provided that one of the Commission's first tasks would be to organize work on the creation of an automatic laboratory for scientific research in cosmic space (an artificial earth satellite). This was to be the first step in solving the problems of interplanetary travel and to allow Soviet scientists to probe more deeply into the secrets of the universe.

110. There is no direct evidence on the priority assigned to the Soviet space program. From the launchings of the Sputniks, from statements by Soviet scientists and high government officials and from the fact that hardware was diverted from the high priority missile program, we believe the inference can be drawn that the Soviet space exploration program has been assigned a very high priority. In many respects Soviet space programs and military missile programs are complementary; we believe, for example, that the Soviet space program has thus far primarily utilized propulsion units developed for the ICBM. There is no evidence to indicate that this has adversely affected the ICBM program, and we believe that the space flight program will not be permitted to interfere with the early achievement of an ICBM capability.

FACTORS AFFECTING ACCOMPLISHMENT OF PROGRAM

111. Prerequisites to the initiation of an extensive space program are the development of large, reliable propulsion units and an advanced electronics program necessary for providing communications, guidance, tracking and data handling. We have estimated that to a large extent, the USSR has already developed these capabilities in the field of ballistic missiles. By utilizing military missile development in the launchings of the first three Sputniks, the USSR has attained an initial success in its program of space exploration. Further successes in the Soviet space program depend upon capabilities in the following fields of scientific and technical endeavor.

112. *Rocket propulsion.* The weights of the three Soviet satellites as announced by the USSR (successively about 184, 1120, and 2900

lbs.) clearly demonstrate Soviet capabilities for development of high thrust rocket engines. Soviet interest in development of higher thrust rocket engines, higher energy fuel combinations, solid propellants and advanced type propulsion systems has been indicated. These are desirable for future launchings of larger satellites and necessary for manned interplanetary space travel.

113. *Guidance, tracking, and communications.* We believe that the USSR is currently capable of placing unmanned vehicles into orbital flights around the earth with certain elements of the orbit approximately predetermined. Achievement of more complex trajectories (e.g., lunar shots) can be expected to evolve from current capabilities. The USSR has an extensive detection, tracking and data handling network for use in its earth satellite program.

114. All three Soviet earth satellites transmitted signals on publicly-announced frequencies. [

] The Soviets have announced that Sputnik III was equipped with memory devices to store collected data; [

] 115. We also have good evidence that the Soviets are making impressive progress in the field of radio astronomy. Although firm connections have not been noted, such Soviet effort can be applied to problems of communications and of tracking and navigation of space vehicles.

116. *Space medicine.* The Soviets are conducting an advanced research program in space medicine. They have made particular progress in studying rocket flight physiology and in developing space flight equipment. Advanced investigations are reported from the Institute of Biological Physics and the Central Scientific Research Institute of Aviation

Medicine in Moscow and at least 25 other major institutes with an unknown number of subordinate laboratories. At least 100 Soviet scientists have been identified as the authors of significant papers in the field.

117. The depth and scope of the Soviet research effort in space medicine indicates an intention to master the fundamentals that underlie human performance and behavior in space. We believe that high altitude rocket experiments with animals have been conducted for several years as announced by the USSR, and additional medical and biological data reportedly have been obtained from the dog in Sputnik II. Research is also being pursued on the effects of acceleration and weightlessness, super saturation of the blood with oxygen, "sealed cabin" experiments, and other problems relating to manned space flight.

118. *Astrobiology.* This field, dealing with the study of possible living organisms on other planets and of the adaptability of earth forms of life to conditions on other planets, is a significant research area in any space program directed toward manned interplanetary flight. Soviet interest in astrobiology is indicated by the assignment in 1956 of research responsibilities in this area to the Interagency Commission for Interplanetary Communications, which appointed a scientific council of outstanding medical scientists to deal with this subject.

119. *Celestial mechanics.* This highly complex subject, which deals with studies of the motions of bodies in outer space under the influence of their mutual gravitational attractions, has an essential role in space flight research. The Soviet Institute of Theoretical Astronomy, the largest of its kind in the world, devotes much of its effort to research in celestial mechanics. There is evidence to indicate that Soviet scientists have made extensive calculations of moon flight trajectories.

120. *Astrophysics and geophysics.* The Soviets are highly competent in the field of astrophysics, and in those aspects of geophysics relating to space travel. In general, the scientific data obtained from satellites or other

space vehicles will have significant value to the USSR, not only in the furtherance of its space research activities, but in the enhancement of its scientific and technological knowledge.

CAPABILITIES TO ACCOMPLISH SPECIFIC OBJECTIVES

121. We believe the Soviets intend to pursue an active space flight program designed to put men into space for scientific and/or military purposes. We also believe they intend to undertake further scientific research utilizing unmanned earth satellites, lunar rockets, and probes of Mars and Venus. The dates given for Soviet space activities estimated in this section represent the earliest possible time periods at which we believe each specific event could be accomplished. We recognize that the space flight program is in competition with many other programs, particularly the missile program, and that the USSR probably cannot successfully accomplish all of the space flight activities described below within the time periods specified. We cannot at this time determine which specific space flight activities enjoy the higher priority and will be pursued first.

122. *Unmanned earth satellites.*¹³ We believe that the USSR could orbit scientific satellites weighing on the order of 5,000 pounds within the next several months. The USSR could probably continue to place into orbit more and perhaps even larger satellites throughout the period of this estimate. As additional scientific data is obtained, the USSR could

¹³ Reported characteristics of Soviet satellites successfully launched to date:

	Sputnik I	Sputnik II	Sputnik III
Weight	184 pounds	1120 pounds	2925 pounds
Length	23 inches	about 9½ feet	11' 8½"
Diameter	23 inches	5 plus feet	5' 8" at base
Orbit	170-580 miles	150-1035 miles	126-1163 miles
Orbit Time	96.2 minutes	103.52 minutes	106 minutes
Shape	sphere	cone	conelike
Lifetime	3 months	5½ months	estimated 6 months

refine or develop new scientific instrumentation to be placed into satellites. Early in the period of this estimate the USSR could place into orbit and recover aeromedical specimens from satellites, to provide essential Soviet knowledge of recovery techniques and of adverse effects of a space environment for man.

123. The USSR could probably orbit surveillance satellites capable of low optical resolution (approximately 100-200 feet) at any time within the next year, to obtain weather data and perhaps some additional data of military intelligence value, such as information on fleet movements. Within another year or two, the USSR could develop more sophisticated surveillance satellites, involving improved photographic or TV reconnaissance, infrared photography and/or ELINT. Such satellites could provide more diverse scientific and military information. The USSR could also develop a communications relay satellite within the period of this estimate, should they elect to do so.

124. *Lunar rockets.* As far as propulsion and guidance requirements are concerned, the USSR has had the capability of launching a probe to the vicinity of the moon since the fall of 1957. A Soviet program of lunar probes could commence with experimental rockets followed by rocket landings on the moon. Placing a satellite into orbit around the moon requires the use of a retro-rocket and more accurate guidance. We believe the USSR could achieve an unmanned lunar satellite in late 1958-1959 and an unmanned lunar soft landing using retro-rockets about six months thereafter.

125. *Manned earth satellites.* Sufficient scientific data could probably have been attained and recovery techniques perfected to permit the USSR to launch a manned satellite into orbital flight and recovery by about 1959-1960. Recovery techniques from a manned satellite, by both capsule and glide vehicle, appear to be feasible and within Soviet capabilities. In view of the wealth of Soviet experience with

ballistic missiles and earth satellite vehicles, we believe that the capsule will be used in the first Soviet attempt to recover a man from orbit.

126. *Planetary probes.* Planetary probe vehicles could utilize existing Soviet ICBM propulsion units for the first stage and presently available guidance components. We believe the USSR could launch probes toward Mars and Venus with a good chance of success. The first launchings toward Mars could occur in August 1958, when Mars will be in the most favorable position relative to the earth. More sophisticated probes could be launched in October 1960, when Mars will again be in a favorable position relative to the earth. Similarly, the first launchings toward Venus could probably occur in June 1959, and more sophisticated probes could be launched in January 1961.

127. *Manned circumlunar flights.* Contingent upon successes with manned earth satellites, the development of a new, large booster engine, and concurrent advances in scientific experimentations with lunar rockets, the USSR could achieve a capability for manned circumlunar flight with reasonable chance for success in about 1961-1962.

128. *Manned lunar landings.* We believe that the USSR will not have a capability for manned lunar landings until sometime after 1965.

129. *Space platforms.* There is insufficient information on the problems involved in constructing platforms in space to permit us to estimate Soviet capabilities in this regard. We believe, however, that the USSR would be capable of placing a very large satellite (say about 25,000 pounds) into orbit in 1961-1962. Such a vehicle could serve some of the scientific functions of a space platform without the difficulties of joining and constructing such a platform in space from parts separately orbited.